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THE MATHEMATICAL MODELLING AND PERFORMANCE EVALUATION OF PAINT MANUFACTURING SYSTEM USING FUZZY RELIABILITY APPROACH

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ABSTRACT

In the present paper, we present a novel method for performance evaluation of a paint manufacturing plant in which five subsystems are connected in series configuration. The mathematical modelling of the system is carried out using the mnemonic rule to formulate C-K differential difference equations. The concept of fuzzy reliability, coverage factor and constant failure and repair densities have been used to analyze the availability and performance of the system. Finally, for a particular case numerical results for fuzzy availability and profit function has been derived with respect to time.

KEYWORDS: *Paint Manufacturing Plant, Fuzzy Availability, Mnemonic Rule & Coverage Factor*

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Original Article

INTRODUCTION

Availability, busy period of repairman and profit function are always consider the key indices of performance analysis of engineering systems. It remains a hot topic of discussion from decades among the researcher. A lot of literature related to availability analysis of engineering systems have been exist. Relevant literature can be found Barlow and Proschan (1965), Cui and Xie (2001), Ram (2013), and Qiu and Cui (2018). Kumar and Malik (2014) evaluated reliability of a computer system with priority to H/W repair over replacement of H/W and up-gradation of S/W subject to MOT and MRT. Most of studies carried out so far based on the conventional approach of reliability theory, i.e., binary state assumption. The system is either operative or failed. Sharma and Khanduja (2013) carried out the performance and availability evaluation of a sugar plant using conventional reliability approach. Kumar et al. (2018) also studied a stochastic model of non-identical redundant systems with priority and preventive maintenance. But, the conventional reliability approach has not extensively acceptable in current engineering systems. Zadeh (1965) presented the basic concepts of fuzzy set theory by giving higher importance to scientific environment. The basic scenario in reliability engineering and it can easily handle all the states that fall between working and failed state. The wide coverage of fuzzy state assumption replaces the conventional reliability theory.

Kaufmann (1975) emphasized on the applications of fuzzy reliability in engineering systems by introducing component failure possibility instead of failure probability. Singer (1990) suggested a new methodology for finding reliability measures by considering repair and failure time variables as triangular fuzzy numbers. Mishra (1992) tried to couple the traditional lambda–tau method with fuzzy set theory to analyze fuzzy reliability of repairable systems.

Cai et al. (1993) proposed fuzzy state as a basis of fuzzy reliability. Fuzzy number arithmetic operations have been used in fuzzy reliability evaluation by Chen (1994). Zuang (1995) analyzed reliability of a system presented by associating the fuzziness to various parameters. Komal et al. (2009, 2010) and Kumar et al. (2012) used these methodologies to assess the reliability of butter–oil, paper, and fertilizer manufacturing plants, waste clean-up manipulator. Time dependent fuzzy sets for reliability evaluation has been introduced by Aliev and Kara (2004). Chen (2003) introduced the vague sets methodology for obtaining fuzzy system reliability. And, Jiang et al. (2007) applied it for reliability evaluation of Mirrored Disk Organizations. Aggarwal et al. (2014) studied the availability and performance of a butter oil production system. Aggarwal et al. (2016) formulated a mathematical model and obtained the results for reliability of the serial processes in feeding system of sugar plant.Li et al. (2017) developed a system reliability analysis method based on fuzzy probability. Kumar and Saini (2017) formulated a mathematical model for a sugar plant using fuzzy reliability approach. The overall performance of an industrial system depends on the availability of the system. Many researcher like Kachitvichyanukul (2012), Sharma and Vishwakarma (2014), etc. used many techniques such as GA, PSO, Markovian and DE algorithms for the performance evaluation of industrial systems. Though, a lot of work has been carried out in the direction of system reliability and performance evaluation but most of problems either studied under conventional approach or computational methodology is very complex and difficult. But, no simple methodology found in the literature for performance evaluation of engineering systems like paint manufacturing plants.

SYSTEM DESCRIPTION

In this section, a detailed description of paint manufacturing plant has been appended. The system consists of five subsystems named as mixer (A), grinding mill (B), dilution (C), Labeling Machine (D) and filling machine (E). The subsystem A, B and C are working on configuration 1-out-of-1: good policy while D and E comprises two units each working in parallel configuration. Repair of the system is considered perfect and sufficient repair facilities are available as and when required. All the failure and repair rates are taken as constant. Chapman-Kolmogorov differential equation developed using mnemonic rule and their numerical solution have been obtained using Runge–Kutta method of order four. The required data for estimation of various failure and repair rates are collected with the help of the maintenance personnel of the paint manufacturing plant situated at Jaipur, India. The flow chart and state transition diagram of paint manufacturing plant are shown in figure-1& 2 respectively.

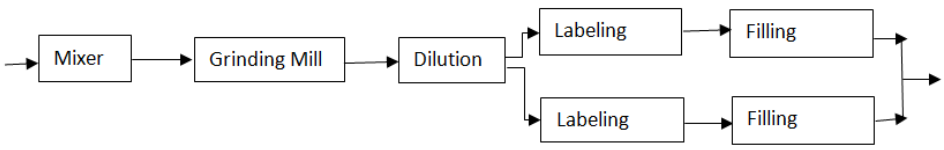

Figure 1: Reliability Block Diagram of the System

MATERIAL AND METHODS

Notations

Symbols	Description
A, B, C, D, E	Working states of the System
D_2, E_2	Both units in subsystem D and E are in working condition
D_1, E_1	Subsystem D and E are in working condition with one failed unit with reduced capacity
a, b, c, d, e	Failed states
C	Coverage factor

$\lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5$	Failure rates of subsystems A, B, C, D, E
λ_6, λ_7	Failure rates of subsystems D, E in reduced capacity
$\mu_1, \mu_2, \mu_3, \mu_4, \mu_5$	Repair rates of subsystems A, B, C, D, E
μ_6, μ_7	Repair rates of subsystems D, E in reduced capacity
$P_i(t)$	Probability that the system is in i^{th} state at time t.

Failure Rate

The ratio of the number of failure of a component in a given time period to the total time period during which system remains operative is termed as constant failure rate (λ_i). It is expresses as the number of failures per unit time.

Repair Rate

The ratio of the number of repairs of a component in a given time period to the total time period during which system repaired is termed as constant repair rate (μ_i). It is expresses as the number of repairs per unit time.

Fuzzy set

Cai (1996) defined the fuzzy sets as a mathematical tool to investigate the real world systems fuzziness. Let $x \in X$ be an element of a conventional set then fuzzy set has been defined as a ordered pair of the element and the corresponding membership function over the interval [0, 1].

Mathematically $A = \{x, \mu_A(x)\}$ over [0, 1]

Membership Function

Let A = {a_1, a_2, a_3… a_n} be a set of possible states. Let $x_{s_i} : a_i \to [0,1]; x_{F_i} : a_i \to [0,1]$. The { x_{s_i} } represent the success variable and { x_{F_i} } represent failure variable. A new function defined as follows:

$$\mu_s = \mu_s(x_{s_1}, x_{s_2}, ..., x_{s_n}) : [0,1]^n \to [0,1]; \ \mu_F = \mu_F(x_{F_1}, x_{F_2}, ..., x_{F_n}) : [0,1]^n \to [0,1]$$

The function μ_s is termed as success membership function and μ_F is the failure membership function. By keeping in mind the complexity of the system, membership function for success is defined as the ratio of operative number of components to the total number of components while, for failure it is defined as the ratio of failed number of components to the total number of components.

Profust Reliability

Cai(1996) defined the profust reliability as

$$R(t_0, t_0 + t) = P\{T_{SF}\, doesn't\, occur\, during\, the\, interval\, (t_0, t_0 + T)\}$$
$$= 1 - \sum_{i=1}^{n} \sum_{j=1}^{n} \mu_{T_{SF}}(m_{ij}) P\{m_{ij}\ occurs\ during\ (t_0, t_0 + T)\}$$

Where m_{ij} is confined to be the transition from state S_i to state S_j without passing via any intermediate state

Fuzzy Availability

Kumar and Kumar (2011) stated a fuzzy probabilistic semi- Markov model {(Sn, Tn), n € N} consisting of 'n' states together with transition time. Let U = {S1, S2,…, Sn} denote the universe of discourse. On this universe, we define a fuzzy success state S, S= $\{(S_i, \mu_S(S_i)); i = 1, 2, \ldots n\}$ and a fuzzy failure state F, $F = \{(S_i, \mu_F(S_i)); i = 1, 2, \ldots n\}$, where $\mu_S(S_i)$ *and* $\mu_F(S_i)$ are trapezoidal fuzzy numbers, respectively. The fuzzy availability of the system is defined as

$A(t) = \sum_{i=1}^{k} \mu_S(S_i) P_i(t)$, where k denotes the operative states

Markov Process

If the state of the system is probability based, the model is a Markov probability model. The fundamental assumption in Markov process is that, the probability P_{ij}, depends entirely on states S_i and S_j, and is independent of all previous states except the last one state S_i

Coverage factor

Kumar and Kumar (2011) stated that the probability of successful reconfiguration operation of a fault-tolerant system is defined as a coverage factor. It is denoted by 'c' and if its value is less than 1, then it is known as imperfect coverage.

Profit function

No one can expect the survival of any industrial if it perform in loss for a long time. The expected performance of the industry in steady state can be measured by its expected profit, i.e ., by the difference of revenue generated per unit time and expenditure per unit time. Mathematically, $\text{Profit} = R_0 FA - R_1 BP$

Where R_0 denotes the generated revenue per unit time and R_1 is the per unit expenditure for various repair activities. Here, FA and BP have been earlier defined.

ASSUMPTIONS

The following assumptions are taken to perform this study

- The failure and repair rates are constant.
- All time dependent random variables are statistically independent.
- Sufficient repair facility available as and when required immediately.
- At the initial time all unit are operative.
- The system works in reduced capacity upon failure of one parallel unit.
- Repair are perfect.

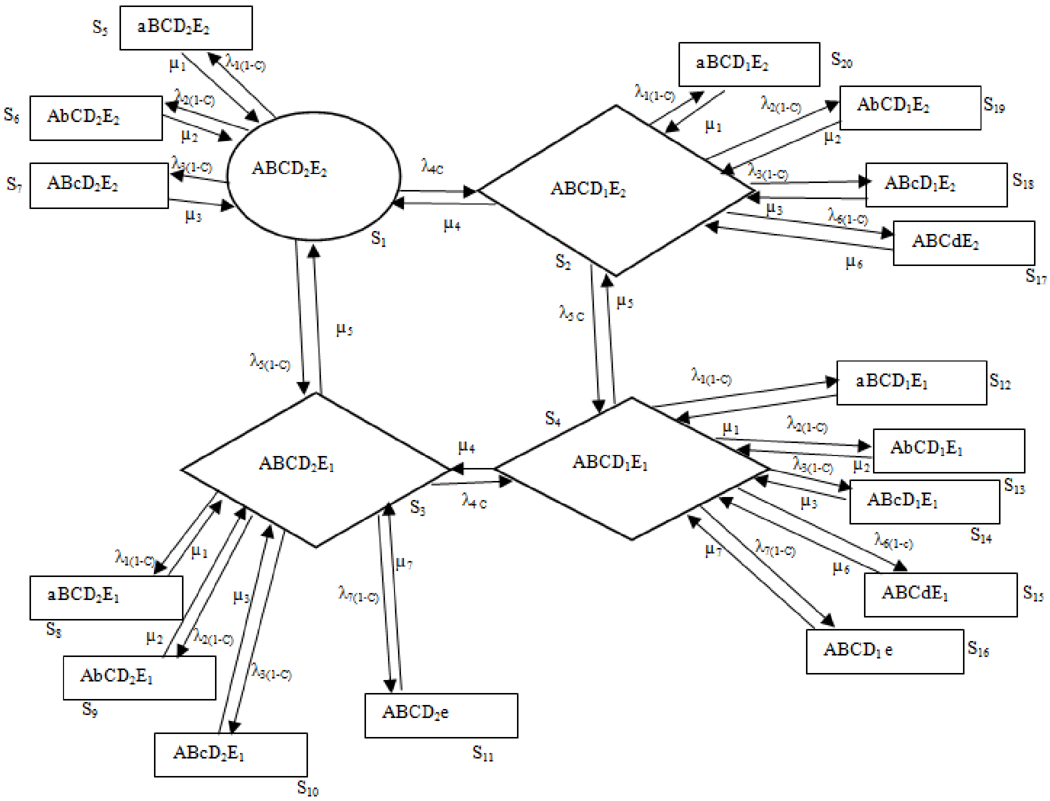

Figure 2: State Transition Diagram

3. FORMULATION OF MATHEMATICAL MODEL AND ITS SOLUTION

In this section, a mathematical modeling is formulated for the system described above by using Markov birth-death process for the three subsystems and the Chapman-Kolmogorov equations are derived. The C-K equations are as follows

$$\frac{dP_1(t)}{dt}+[(1-c)\lambda_1+(1-c)\lambda_2+(1-c)\lambda_3+c\lambda_4+(1-c)\lambda_5]P_1(t) \\ =\mu_1P_5(t)+\mu_2P_6(t)+\mu_3P_7(t)+\mu_4P_2(t)+\mu_5P_3(t) \quad (1)$$

$$\frac{dP_2(t)}{dt}+[(1-c)\lambda_1+(1-c)\lambda_2+(1-c)\lambda_3+(1-c)\lambda_6+c\lambda_5+\mu_4]P_2(t) \\ =c\lambda_4P_1(t)+\mu_1P_{20}(t)+\mu_2P_{19}(t)+\mu_3P_{18}(t)+\mu_6P_{17}(t)+\mu_5P_4(t) \quad (2)$$

$$\frac{dP_3(t)}{dt}+[(1-c)\lambda_1+(1-c)\lambda_2+(1-c)\lambda_3+(1-c)\lambda_7+c\lambda_4+\mu_5]P_3(t) \\ =(1-c)\lambda_5P_1(t)+\mu_1P_8(t)+\mu_2P_9(t)+\mu_4P_4(t)+\mu_7P_{11}(t)+\mu_3P_{10}(t) \quad (3)$$

$$\frac{dP_4(t)}{dt}+[\mu_4+\mu_5+(1-c)\lambda_1+(1-c)\lambda_2+(1-c)\lambda_6+(1-c)\lambda_3+(1-c)\lambda_7]P_4(t) \\ =c\lambda_4P_3(t)+c\lambda_5P_2(t)+\mu_1P_{12}(t)+\mu_2P_{13}(t)+\mu_3P_{14}(t)+\mu_6P_{15}(t)+\mu_7P_{16}(t) \quad (4)$$

$$\frac{dP_5(t)}{dt}+\mu_1P_5(t)=(1-c)\lambda_1P_1(t) \tag{5}$$

$$\frac{dP_6(t)}{dt}+\mu_2P_6(t)=(1-c)\lambda_2P_1(t) \tag{6}$$

$$\frac{dP_7(t)}{dt}+\mu_3P_7(t)=(1-c)\lambda_3P_1(t) \tag{7}$$

$$\frac{dP_8(t)}{dt}+\mu_1P_8(t)=(1-c)\lambda_1P_3(t) \tag{8}$$

$$\frac{dP_9(t)}{dt}+\mu_2P_9(t)=(1-c)\lambda_2P_3(t) \tag{9}$$

$$\frac{dP_{10}(t)}{dt}+\mu_3P_{10}(t)=(1-c)\lambda_3P_3(t) \tag{10}$$

$$\frac{dP_{11}(t)}{dt}+\mu_7P_{11}(t)=(1-c)\lambda_7P_3(t) \tag{11}$$

$$\frac{dP_{12}(t)}{dt}+\mu_1P_{12}(t)=(1-c)\lambda_1P_4(t) \tag{12}$$

$$\frac{dP_{13}(t)}{dt}+\mu_2P_{13}(t)=(1-c)\lambda_2P_4(t) \tag{13}$$

$$\frac{dP_{14}(t)}{dt}+\mu_3P_{14}(t)=(1-c)\lambda_3P_4(t) \tag{14}$$

$$\frac{dP_{15}(t)}{dt}+\mu_6P_{15}(t)=(1-c)\lambda_6P_4(t) \tag{15}$$

$$\frac{dP_{16}(t)}{dt}+\mu_7P_{16}(t)=(1-c)\lambda_7P_4(t) \tag{16}$$

$$\frac{dP_{17}(t)}{dt}+\mu_6P_{17}(t)=(1-c)\lambda_6P_2(t) \tag{17}$$

$$\frac{dP_{18}(t)}{dt}+\mu_3P_{18}(t)=(1-c)\lambda_3P_2(t) \tag{18}$$

$$\frac{dP_{19}(t)}{dt}+\mu_2P_{19}(t)=(1-c)\lambda_2P_2(t) \tag{19}$$

$$\frac{dP_{20}(t)}{dt}+\mu_1P_{20}(t)=(1-c)\lambda_1P_2(t) \tag{20}$$

Initial Condition $P_i(0)=\begin{Bmatrix} 1 & if\ i=0 \\ 0 & if\ i\neq 0 \end{Bmatrix}$ (21)

The system of differential equations (1) to (20) along with initial conditions given in equation (21) was solved by Runge-Kutta fourth-order method. The fuzzy availability and fuzzy profit of the paint manufacturing plant is computed for time 60-360 days. In the numerical computation, it is considered that the failure and repair rates of labeling and filling subsystems are different. The data concerning the failure and repair rates are taken from plant persons as follows:

Table 1: Various Failure and Repair Rates

Name of Subsystem	Failure rate (λ_i)	Repair rate (μ_i)
Mixer	$\lambda_1=0.005$	$\mu_1=0.889$
Grinding mill	$\lambda_2=0.051$	$\mu_2=1.397$
Dilution	$\lambda_3=0.0052$	$\mu_3=0.998$
Labeling	$\lambda_4=0.0727$	$\mu_4=1.232$
Filling	$\lambda_5=0.0954$	$\mu_5=1.244$
Standby Labeling Machine	$\lambda_6=0.0778$	$\mu_6=1.374$
Standby Filling Machine	$\lambda_7=0.0955$	$\mu_7=1.387$

Fuzzy Availability

$$FA=P_1(t)+\frac{6}{7}P_2(t)+\frac{6}{7}P_3(t)+\frac{5}{7}P_4(t) \tag{22}$$

Fuzzy Busy Period:

$$\begin{aligned} FBP=&\frac{1}{7}P_2(t)+\frac{1}{7}P_3(t)+\frac{2}{7}P_4(t)+\frac{1}{7}P_5(t)+\frac{1}{7}P_6(t)+\frac{1}{7}P_7(t)+\frac{2}{7}P_8(t)+\frac{2}{7}P_9(t)+\frac{2}{7}P_{10}(t)\\ &+\frac{2}{7}P_{11}(t)+\frac{3}{7}P_{12}(t)+\frac{3}{7}P_{13}(t)+\frac{3}{7}P_{14}(t)+\frac{3}{7}P_{15}(t)+\frac{3}{7}P_{16}(t)+\frac{2}{7}P_{17}(t)+\frac{2}{7}P_{18}(t)+\frac{2}{7}P_{19}(t)\\ &+\frac{2}{7}P_{20}(t) \end{aligned} \tag{23}$$

Fuzzy profit Function:

$$FP=50000*(FA)-5000*(FBP) \tag{24}$$

Performance Analysis

In this section, the fuzzy availability, fuzzy busy period and fuzzy profit function of the system are computed using equations (22) - (24) respectively. The effect of change of various failure and repair rate of subsystems and coverage factor on these measure with respect to time is appended in tables 2-8.

Effect of Failure and Repair Rate of Subsystem Named Mixer on the Fuzzy Availability and Profit Function

The effect of failure rate of subsystem named mixer on fuzzy availability and profit function of paint manufacturing plant has been studied by varying values as $\lambda_1 = 0.005$ to $\lambda_1 = 0.05$ at a repair rate $\mu_1 = 0.889$ for different values of coverage factor 'C'. The failure and repair rates of other subsystems have been taken constant as given in table-1. The numerical results of fuzzy availability and profit function of system based on this data is appended in table-2. From table-2, it is analyzed that the availability and profit of system model decreases very low with respect to time. This table shows that fuzzy availability and profit decreases 2.75% approximately with the decrease of the coverage factor value C=1 to C=0. While, by increasing the failure rate the value of these measures decrease from 0.99% to 4.61% with respect to coverage factor value except for C=1.

Similarly, repair rate of subsystem named mixer on fuzzy availability and profit function of paint manufacturing plant has been studied by varying values as $\mu_1 = 0.889$ to $\mu_1 = 1.2$ at a failure rate $\lambda_1 = 0.005$ for different values of coverage factor 'C'. The failure and repair rates of other subsystems have been taken constant as given in table-1. The numerical results of fuzzy availability and profit function of system based on this data is appended in table-2. From table-2, it is analyzed that the availability and profit of system model decreases very low with respect to time. This table shows that fuzzy availability and profit increases 0.13% approximately with the decrease of the coverage factor value C=1 to C=0 after increasing the repair rate. It is also noted that increase or decrease failure rate does not shows any effect on fuzzy availability and profit at the state of full coverage, i.e., C=1. Finally, we conclude that the maximum value of fuzzy availability and profit are 0.981865 and 49002.56 respectively.

Table 2: Effect of Failure and Repair Rates of Mixer on Fuzzy Availability and Profit Function

Coverage Factor	Time (Days)	Availability with Respect to Failure & Repair Rates of Mixer Unit			Profit with Respect to Failure & Repair Rates of Mixer Unit		
		$\mu_1 = 0.889$ $\lambda_1 = 0.005$	$\mu_1 = 0.889$ $\lambda_1 = 0.05$	$\mu_1 = 1.2$ $\lambda_1 = 0.005$	$\mu_1 = 0.889$ $\lambda_1 = 0.005$	$\mu_1 = 0.889$ $\lambda_1 = 0.05$	$\mu_1 = 1.2$ $\lambda_1 = 0.005$
C=1	40	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	80	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	120	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	160	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	200	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	240	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	280	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	320	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	360	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
C=0.8	40	0.974799	0.965132	0.97508	48657.97	48167.65	48672.24
	80	0.974799	0.965132	0.97508	48657.97	48167.65	48672.24
	120	0.974799	0.965132	0.97508	48657.97	48167.65	48672.24
	160	0.974799	0.965132	0.97508	48657.97	48167.65	48672.24
	200	0.974799	0.965132	0.97508	48657.97	48167.64	48672.24
	240	0.974799	0.965132	0.97508	48657.97	48167.65	48672.24
	280	0.974799	0.965132	0.97508	48657.97	48167.65	48672.24
	320	0.974799	0.965132	0.97508	48657.97	48167.65	48672.24
	360	0.974799	0.965132	0.97508	48657.97	48167.65	48672.24
C=0.4	40	0.963157	0.935581	0.963975	48097.67	46699.06	48139.16
	80	0.963157	0.935581	0.963975	48097.67	46699.07	48139.16
	120	0.963157	0.935581	0.963975	48097.67	46699.06	48139.17

Table 2: Contd.,

	160	0.963157	0.935581	0.963975	48097.67	46699.06	48139.17
	200	0.963157	0.935581	0.963975	48097.67	46699.06	48139.17
	240	0.963157	0.935581	0.963975	48097.67	46699.06	48139.17
	280	0.963157	0.935581	0.963975	48097.67	46699.06	48139.17
	320	0.963157	0.935581	0.963975	48097.67	46699.06	48139.17
	360	0.963157	0.935581	0.963975	48097.67	46699.06	48139.16
C=0	40	0.9548	0.910775	0.956131	47707.69	45476.04	47776.21
	80	0.954799	0.910768	0.95613	47707.68	45475.66	47776.18
	120	0.954797	0.910748	0.956159	47707.52	45475.66	47776.65
	160	0.954796	0.910741	0.956127	47707.49	45475.31	47775.9
	200	0.954795	0.910736	0.956119	47707.57	45475.03	47775.89
	240	0.954794	0.910724	0.956103	47707.42	45474.9	47775.79
	280	0.954793	0.910712	0.956093	47707.37	45474.87	47775.33
	320	0.954791	0.910703	0.956087	47707.26	45474.78	47775.26
	360	0.95479	0.910695	0.956065	47707.09	45474.04	47775.21

The effect of failure and repair rate of subsystem named Grinding mill on fuzzy availability and profit function of paint manufacturing plant have been studied by varying values as $\lambda_2 = 0.051$ to $\lambda_2 = 0.06$ at a repair rate $\mu_2 = 1.397$ and $\mu_2 = 1.397$ to $\mu_2 = 1.92$ at a failure rate $\lambda_2 = 0.051$ respectively for different values of coverage factor 'C'. The failure and repair rates of other subsystems have been taken constant as given in table-1. The numerical results of fuzzy availability and profit function of system based on this data is appended in table-3. From table-3, it is analyzed that the availability and profit of system model decreases very low with respect to time. This table shows that fuzzy availability and profit increases 0.95% approximately with the increase of the repair rate along with coverage factor value C=1 to C=0. However, value of these measures decrease 2.75% with the increase of failure rate. It is also noted that increase or decrease failure rate does not shows any effect on fuzzy availability and profit at the state of full coverage, i. e., C=1. Finally, we conclude that the maximum value of fuzzy availability and profit are 0.981865 and 49002.56 respectively.

Table 3: Effect of Failure and Repair Rates of Grinding Mill on Fuzzy Availability and Profit Function

Coverage Factor	Time (Days)	Availability with Respect to Failure & Repair Rates of Grinding Unit			Profit with Respect to Failure & Repair Rates of Grinding Unit		
		$\mu_2 = 1.397$ $\lambda_2 = 0.051$	$\mu_2 = 1.397$ $\lambda_2 = 0.06$	$\mu_2 = 1.92$ $\lambda_2 = 0.005$	$\mu_2 = 1.397$ $\lambda_2 = 0.051$	$\mu_2 = 1.397$ $\lambda_2 = 0.06$	$\mu_2 = 1.92$ $\lambda_2 = 0.005$
C=1	40	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	80	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	120	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	160	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	200	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	240	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	280	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	320	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	360	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
C=0.8	40	0.974799	0.973558	0.976721	48657.97	48595.02	48755.46
	80	0.974799	0.973558	0.976721	48657.97	48595.02	48755.46
	120	0.974799	0.973558	0.976721	48657.97	48595.02	48755.46
	160	0.974799	0.973558	0.976721	48657.97	48595.02	48755.46
	200	0.974799	0.973558	0.976721	48657.97	48595.02	48755.46
	240	0.974799	0.973558	0.976721	48657.97	48595.02	48755.46
	280	0.974799	0.973558	0.976721	48657.97	48595.02	48755.46
	320	0.974799	0.973558	0.976721	48657.97	48595.02	48755.46
	360	0.974799	0.973558	0.976721	48657.97	48595.02	48755.46
C=0.4	40	0.963157	0.959557	0.968766	48097.67	47915.1	48382.18

Table 3: Contd.,							
	80	0.963157	0.959557	0.968766	48097.67	47915.1	48382.18
	120	0.963157	0.959557	0.968766	48097.67	47915.1	48382.18
	160	0.963157	0.959557	0.968766	48097.67	47915.1	48382.18
	200	0.963157	0.959557	0.968766	48097.67	47915.1	48382.18
	240	0.963157	0.959557	0.968766	48097.67	47915.1	48382.18
	280	0.963157	0.959557	0.968766	48097.67	47915.1	48382.18
	320	0.963157	0.959557	0.968766	48097.67	47915.1	48382.18
	360	0.963157	0.959557	0.968766	48097.67	47915.1	48382.18
C=0	40	0.9548	0.948955	0.963969	47707.69	47411.28	48172.7
	80	0.954799	0.948971	0.963968	47707.68	47411.08	48172.65
	120	0.954797	0.94892	0.963954	47707.52	47411.52	48171.97
	160	0.954796	0.949008	0.96395	47707.49	47411.47	48171.76
	200	0.954795	0.94895	0.963956	47707.47	47411.04	48171.55
	240	0.954794	0.94897	0.963958	47707.42	47411.03	48171.44
	280	0.954793	0.948972	0.963956	47707.37	47410.97	48171.26
	320	0.954791	0.948977	0.963957	47707.26	47410.43	48171.18
	360	0.95479	0.948955	0.963969	47707.09	47410.28	48171.07

The effect of failure and repair rates of subsystem named Dilution on fuzzy availability and profit function of paint manufacturing plant has been studied by varying values as $\lambda_3 = 0.0052$ to $\lambda_3 = 0.061$ at a repair rate $\mu_3 = 0.998$ and $\mu_3 = 0.998$ to $\mu_3 = 1.3$ at a failure rate $\lambda_3 = 0.0052$ for different values of coverage factor 'C'. The failure and repair rates of other subsystems have been taken constant as given in table-1. The numerical results of fuzzy availability and profit function of system based on this data is appended in table-3. From table-3, it is analyzed that the availability and profit of system model decreases very low with respect to time. This table shows that fuzzy availability and profit increases with the decrease of the coverage factor value C=1 to C=0 and failure rate while, increase with the increase of repair rate. It is also noted that increase or decrease failure rate does not shows any effect on fuzzy availability and profit at the state of full coverage, i.e., C=1. Finally, we conclude that the maximum value of fuzzy availability and profit are 0.981865 and 49002.56 respectively.

Table 4: Effect of Failure and Repair Rates of Dilution on Fuzzy availability and Profit Function

Coverage Factor	Time (Days)	Availability with Respect to Failure & Repair Rates of Dilution Unit			Profit with Respect to Failure & Repair Rates of Dilution Unit		
		$\mu_3 = 0.998$ $\lambda_3 = 0.0052$	$\mu_3 = 0.998$ $\lambda_3 = 0.061$	$\mu_3 = 1.3$ $\lambda_3 = 0.0052$	$\mu_3 = 0.998$ $\lambda_3 = 0.0052$	$\mu_3 = 0.998$ $\lambda_3 = 0.061$	$\mu_3 = 1.3$ $\lambda_3 = 0.0052$
C=1	40	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	80	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	120	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	160	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	200	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	240	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	280	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	320	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	360	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
C=0.8	40	0.974799	0.964133	0.975033	48657.97	48116.93	48669.82
	80	0.974799	0.964133	0.975033	48657.97	48116.93	48669.82
	120	0.974799	0.964133	0.975033	48657.97	48116.93	48669.82
	160	0.974799	0.964133	0.975033	48657.97	48116.93	48669.82
	200	0.974799	0.964133	0.975033	48657.97	48116.93	48669.82
	240	0.974799	0.964133	0.975033	48657.97	48116.93	48669.82
	280	0.974799	0.964133	0.975033	48657.97	48116.93	48669.82
	320	0.974799	0.964133	0.975033	48657.97	48116.93	48669.82
	360	0.974799	0.964133	0.975033	48657.97	48116.93	48669.82

Table 4: Contd.,

C=0.4	40	0.963157	0.932788	0.963836	48097.67	46557.43	48132.12
	80	0.963157	0.932788	0.963836	48097.67	46557.42	48132.12
	120	0.963157	0.932788	0.963836	48097.67	46557.43	48132.12
	160	0.963157	0.932788	0.963836	48097.67	46557.42	48132.12
	200	0.963157	0.932788	0.963836	48097.67	46557.43	48132.12
	240	0.963157	0.932788	0.963836	48097.67	46557.42	48132.12
	280	0.963157	0.932788	0.963836	48097.67	46557.43	48132.12
	320	0.963157	0.932788	0.963836	48097.67	46557.42	48132.12
	360	0.963157	0.932788	0.963836	48097.67	46557.43	48132.12
C=0	40	0.9548	0.906413	0.955914	47707.69	45253.29	47763.7
	80	0.954799	0.906406	0.955905	47707.68	45253.94	47763.7
	120	0.954797	0.906379	0.955899	47707.52	45252.08	47763.43
	160	0.954796	0.906345	0.955881	47707.49	45251.43	47763.34
	200	0.954795	0.906316	0.955872	47707.47	45250.94	47763.26
	240	0.954794	0.906287	0.955863	47707.42	45250.51	47763.16
	280	0.954793	0.906205	0.955849	47707.37	45250.41	47763.06
	320	0.954791	0.906192	0.955814	47707.26	45250.33	47762.23
	360	0.95479	0.906173	0.955804	47707.09	45250.29	47761.7

The effect of failure and repair rate of subsystem named labeling machine (when both unit work in parallel) on fuzzy availability and profit function of paint manufacturing plant have been studied by varying values as $\lambda_4 = 0.0727$ to $\lambda_4 = 0.8$ at a repair rate $\mu_4 = 1.232$ and $\mu_4 = 1.232$ to $\mu_4 = 1.69$ at a failure rate $\lambda_4 = 0.0727$ for different values of coverage factor 'C'. The failure and repair rates of other subsystems have been taken constant as given in table-1. The numerical results of fuzzy availability and profit function of system based on this data is appended in table-5. From table-5, it is analyzed that the availability and profit of system model decreases very low with respect to time. This table shows that fuzzy availability and profit increases 0.21% approximately with the decrease of the coverage factor value C=1 to C=0 after increasing the repair rate. However, the availability and profit decline immediately 5.14% with the increase of failure rate of labeling machine. Finally, we conclude that the maximum value of fuzzy availability and profit are 0.983933 and 49116.31 respectively.

Table 5: Effect of Failure and Repair Rates of Labeling Machine on Fuzzy availability and Profit Function

Coverage Factor	Time (days)	Availability with Respect to Failure & Repair Rates of Labeling Unit			Profit with Respect to Failure & Repair Rates of Labeling Unit		
		$\mu_4=1.232$ $\lambda_4=0.0727$	$\mu_4=1.232$ $\lambda_4=0.8$	$\mu_4=1.69$ $\lambda_4=0.0727$	$\mu_4=1.232$ $\lambda_4=0.0727$	$\mu_4=1.232$ $\lambda_4=0.8$	$\mu_4=1.69$ $\lambda_4=0.0727$
C=1	40	0.981865	0.933582	0.983933	49002.56	46347	49116.31
	80	0.981865	0.933582	0.983933	49002.56	46347	49116.31
	120	0.981865	0.933582	0.983933	49002.56	46347	49116.31
	160	0.981865	0.933582	0.983933	49002.56	46347	49116.31
	200	0.981865	0.933582	0.983933	49002.56	46347	49116.31
	240	0.981865	0.933582	0.983933	49002.56	46347	49116.31
	280	0.981865	0.933582	0.983933	49002.56	46347	49116.31
	320	0.981865	0.933582	0.983933	49002.56	46347	49116.31
	360	0.981865	0.933582	0.983933	49002.56	46347	49116.31
C=0.8	40	0.974799	0.929759	0.976597	48657.97	46190.19	48756.51
	80	0.974799	0.929759	0.976597	48657.97	46190.19	48756.51
	120	0.974799	0.929759	0.976597	48657.97	46190.19	48756.51
	160	0.974799	0.929759	0.976597	48657.97	46190.2	48756.51
	200	0.974799	0.929759	0.976597	48657.97	46190.19	48756.51
	240	0.974799	0.929759	0.976597	48657.97	46190.19	48756.51
	280	0.974799	0.929759	0.976597	48657.97	46190.19	48756.51
	320	0.974799	0.929759	0.976597	48657.97	46190.19	48756.51

Table 5: Contd.,							
	360	0.974799	0.929759	0.976597	48657.97	46190.19	48756.51
C=0.4	40	0.963157	0.93214	0.964204	48097.67	46408.58	48154.69
	80	0.963157	0.93214	0.964204	48097.67	46408.58	48154.69
	120	0.963157	0.93214	0.964204	48097.67	46408.57	48154.69
	160	0.963157	0.93214	0.964204	48097.67	46408.58	48154.69
	200	0.963157	0.93214	0.964204	48097.67	46408.58	48154.69
	240	0.963157	0.93214	0.964204	48097.67	46408.57	48154.69
	280	0.963157	0.93214	0.964204	48097.67	46408.58	48154.69
	320	0.963157	0.93214	0.964204	48097.67	46408.57	48154.69
	360	0.963157	0.93214	0.964204	48097.67	46408.58	48154.69
C=0	40	0.9548	0.9548	0.9548	47707.69	47707.69	47707.69
	80	0.954799	0.954799	0.954799	47707.68	47707.68	47707.68
	120	0.954797	0.954797	0.954797	47707.52	47707.52	47707.52
	160	0.954796	0.954796	0.954796	47707.49	47707.49	47707.49
	200	0.954795	0.954795	0.954795	47707.47	47707.47	47707.47
	240	0.954794	0.954794	0.954794	47707.42	47707.42	47707.42
	280	0.954793	0.954793	0.954793	47707.37	47707.37	47707.37
	320	0.954791	0.954791	0.954791	47707.26	47707.26	47707.26
	360	0.95479	0.95479	0.95479	47707.09	47707.09	47707.09

The effect of failure and repair rate of subsystem named filling machine (when both unit work in parallel) on fuzzy availability and profit function of paint manufacturing plant have been studied by varying values as $\lambda_5 = 0.0954$ to $\lambda_5 = 0.9$ at a repair rate $\mu_5 = 1.244$ and $\mu_5 = 1.244$ to $\mu_5 = 1.7$ at a failure rate $\lambda_5 = 0.0954$ for different values of coverage factor 'C'. The failure and repair rates of other subsystems have been taken constant as given in table-1. The numerical results of fuzzy availability and profit function of system based on this data is appended in table-6. From table-6, it is analyzed that the availability and profit of system model decreases very low with respect to time but it rapidly decrease with decrease of the coverage factor value C=1 to C=0. This table shows that fuzzy availability and profit increases 0.26after increasing the repair rate. However, the availability and profit decline immediately 5.34% with the increase of failure rate of filling machine. Finally, we conclude that the maximum value of fuzzy availability and profit are 0.984449 and 49144.69 respectively.

Table 6: Effect of Failure and Repair Rates of Filling Machine on Fuzzy Availability and Profit Function

Coverage Factor	Time (Days)	Availability with Respect to Failure & Repair Rates of Filling Unit			Profit with Respect to Failure & Repair Rates of Filling Unit		
		$\mu_5 = 1.244$ $\lambda_5 = 0.0954$	$\mu_5 = 1.244$ $\lambda_5 = 0.9$	$\mu_5 = 1.7$ $\lambda_5 = 0.0954$	$\mu_5 = 1.244$ $\lambda_5 = 0.0954$	$\mu_5 = 1.244$ $\lambda_5 = 0.9$	$\mu_5 = 1.7$ $\lambda_5 = 0.0954$
C=1	40	0.981865	0.932072	0.984449	49002.56	46263.95	49144.69
	80	0.981865	0.932072	0.984449	49002.56	46263.95	49144.69
	120	0.981865	0.932072	0.984449	49002.56	46263.95	49144.69
	160	0.981865	0.932072	0.984449	49002.56	46263.95	49144.69
	200	0.981865	0.932072	0.984449	49002.56	46263.95	49144.69
	240	0.981865	0.932072	0.984449	49002.56	46263.95	49144.69
	280	0.981865	0.932072	0.984449	49002.56	46263.95	49144.69
	320	0.981865	0.932072	0.984449	49002.56	46263.95	49144.69
	360	0.981865	0.932072	0.984449	49002.56	46263.95	49144.69
C=0.8	40	0.974799	0.927255	0.977094	48657.97	46055.52	48783.59
	80	0.974799	0.927255	0.977094	48657.97	46055.52	48783.58
	120	0.974799	0.927255	0.977094	48657.97	46055.52	48783.59
	160	0.974799	0.927255	0.977094	48657.97	46055.52	48783.58
	200	0.974799	0.927255	0.977094	48657.97	46055.52	48783.59
	240	0.974799	0.927255	0.977094	48657.97	46055.52	48783.58
	280	0.974799	0.927255	0.977094	48657.97	46055.52	48783.58

Table 6: Contd.,

	320	0.974799	0.927255	0.977094	48657.97	46055.52	48783.59
	360	0.974799	0.927255	0.977094	48657.97	46055.52	48783.59
C=0.4	40	0.963157	0.928917	0.964541	48097.67	46237.12	48172.9
	80	0.963157	0.928917	0.964541	48097.67	46237.11	48172.9
	120	0.963157	0.928917	0.964541	48097.67	46237.12	48172.9
	160	0.963157	0.928917	0.964541	48097.67	46237.12	48172.9
	200	0.963157	0.928917	0.964541	48097.67	46237.12	48172.9
	240	0.963157	0.928917	0.964541	48097.67	46237.12	48172.9
	280	0.963157	0.928917	0.964541	48097.67	46237.12	48172.9
	320	0.963157	0.928917	0.964541	48097.67	46237.12	48172.9
	360	0.963157	0.928917	0.964541	48097.67	46237.12	48172.9
C=0	40	0.9548	0.9548	0.9548	47707.69	47707.69	47707.69
	80	0.954799	0.954799	0.954799	47707.68	47707.68	47707.68
	120	0.954797	0.954797	0.954797	47707.52	47707.52	47707.52
	160	0.954796	0.954796	0.954796	47707.49	47707.49	47707.49
	200	0.954795	0.954795	0.954795	47707.47	47707.47	47707.47
	240	0.954794	0.954794	0.954794	47707.42	47707.42	47707.42
	280	0.954793	0.954793	0.954793	47707.37	47707.37	47707.37
	320	0.954791	0.954791	0.954791	47707.26	47707.26	47707.26
	360	0.95479	0.95479	0.95479	47707.09	47707.09	47707.09

The effect of failure and repair rate of subsystem named labeling machine (when only standby unit is operative) on fuzzy availability and profit function of paint manufacturing plant has been studied by varying values as $\lambda_6 = 0.0778$ to $\lambda_6 = 0.72$ at a repair rate $\mu_6 = 1.374$ and $\mu_6 = 1.374$ to $\mu_6 = 1.89$ at a failure rate $\lambda_6 = 0.0778$ for different values of coverage factor 'C'. The failure and repair rates of other subsystems have been taken constant as given in table-1. The numerical results of fuzzy availability and profit function of system based on this data is appended in table-7. From table-7, it is analyzed that the availability and profit of system model decreases very low with respect to time, but very rapidly with respect to coverage factor. This table shows that fuzzy availability and profit increases with increase of the repair rate. However, the availability and profit decline immediately with the increase of failure rate of standby labeling machine. It is also noted that increase or decrease failure rate does not shows any effect on fuzzy availability and profit at the state of full coverage, i.e., C=1. Finally, we conclude that the maximum value of fuzzy availability and profit are 0.981865 and 49002.56 respectively.

Table 7: Effect of Failure and Repair Rates of Standby Labeling Machine on Fuzzy Availability and Profit Function

Coverage Factor	Time (Days)	Availability with Respect to Failure & Repair Rates of Standby Labeling Unit			Profit with Respect to Failure & Repair Rates of Standby Labeling Unit		
		$\mu_6 = 1.374$ $\lambda_6 = 0.0778$	$\mu_6 = 1.374$ $\lambda_6 = 0.72$	$\mu_6 = 1.89$ $\lambda_6 = 0.0778$	$\mu_6 = 1.374$ $\lambda_6 = 0.0778$	$\mu_6 = 1.374$ $\lambda_6 = 0.72$	$\mu_6 = 1.89$ $\lambda_6 = 0.0778$
C=1	40	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	80	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	120	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	160	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	200	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	240	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	280	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	320	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	360	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
C=0.8	40	0.974799	0.970752	0.974933	48657.97	48449.86	48664.89
	80	0.974799	0.970752	0.974933	48657.97	48449.85	48664.89
	120	0.974799	0.970752	0.974933	48657.97	48449.86	48664.89
	160	0.974799	0.970752	0.974933	48657.97	48449.86	48664.89

Table 7: Contd.,							
	200	0.974799	0.970752	0.974933	48657.97	48449.85	48664.89
	240	0.974799	0.970752	0.974933	48657.97	48449.85	48664.89
	280	0.974799	0.970752	0.974933	48657.97	48449.86	48664.89
	320	0.974799	0.970752	0.974933	48657.97	48449.85	48664.89
	360	0.974799	0.970752	0.974933	48657.97	48449.86	48664.89
C=0.4	40	0.963157	0.95715	0.963357	48097.67	47788.65	48107.96
	80	0.963157	0.95715	0.963357	48097.67	47788.66	48107.96
	120	0.963157	0.95715	0.963357	48097.67	47788.65	48107.96
	160	0.963157	0.95715	0.963357	48097.67	47788.66	48107.96
	200	0.963157	0.95715	0.963357	48097.67	47788.66	48107.95
	240	0.963157	0.95715	0.963357	48097.67	47788.65	48107.96
	280	0.963157	0.95715	0.963357	48097.67	47788.65	48107.95
	320	0.963157	0.95715	0.963357	48097.67	47788.65	48107.96
	360	0.963157	0.95715	0.963357	48097.67	47788.65	48107.96
C=0	40	0.9548	0.9548	0.9548	47707.69	47707.69	47707.69
	80	0.954799	0.954799	0.954799	47707.68	47707.68	47707.68
	120	0.954797	0.954797	0.954797	47707.52	47707.52	47707.52
	160	0.954796	0.954796	0.954796	47707.49	47707.49	47707.49
	200	0.954795	0.954795	0.954795	47707.47	47707.47	47707.47
	240	0.954794	0.954794	0.954794	47707.42	47707.42	47707.42
	280	0.954793	0.954793	0.954793	47707.37	47707.37	47707.37
	320	0.954791	0.954791	0.954791	47707.26	47707.26	47707.26
	360	0.95479	0.95479	0.95479	47707.09	47707.09	47707.09

The effect of failure and repair rate of subsystem named filling machine (when only standby unit is operative) on fuzzy availability and profit function of paint manufacturing plant has been studied by varying values as $\lambda_7 = 0.0955$ to $\lambda_7 = 0.94$ at a repair rate $\mu_7 = 1.387$ and $\mu_7 = 1.387$ to $\mu_7 = 1.9$ at a failure rate $\lambda_7 = 0.0955$ for different values of coverage factor 'C'. The failure and repair rates of other subsystems have been taken constant as given in table-1. The numerical results of fuzzy availability and profit function of system based on this data is appended in table-8. From table-8, it is analyzed that the availability and profit of system model decreases very low with respect to time, but very rapidly with respect to coverage factor. This table shows that fuzzy availability and profit increases with increase of the repair rate. However, the availability and profit decline immediately with the increase of failure rate of standby labeling machine. It is also noted that increase or decrease failure rate does not shows any effect on fuzzy availability and profit at the state of full coverage, i.e., C=1. Finally, we conclude that the maximum value of fuzzy availability and profit are 0.981865 and 49002.56 respectively.

Table 8: Effect of Failure and Repair Rates of Standby Filling Machine on Fuzzy Availability and Profit Function

Coverage Factor	Time (Days)	Availability with Respect to Failure & Repair Rates of Standby Filling Unit			Profit with Respect to Failure & Repair Rates of Standby Filling Unit		
		$\mu_7 = 1.387$ $\lambda_7 = 0.0955$	$\mu_7 = 1.387$ $\lambda_7 = 0.94$	$\mu_7 = 1.9$ $\lambda_7 = 0.0955$	$\mu_7 = 1.387$ $\lambda_7 = 0.0955$	$\mu_7 = 1.387$ $\lambda_7 = 0.94$	$\mu_7 = 1.9$ $\lambda_7 = 0.0955$
C=1	40	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	80	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	120	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	160	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	200	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	240	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	280	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	320	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
	360	0.981865	0.981865	0.981865	49002.56	49002.56	49002.56
C=0.8	40	0.974799	0.968057	0.975006	48657.97	48311.36	48668.63
	80	0.974799	0.968057	0.975006	48657.97	48311.36	48668.63

Table 8: Contd.,

	120	0.974799	0.968057	0.975006	48657.97	48311.36	48668.63
	160	0.974799	0.968057	0.975006	48657.97	48311.36	48668.63
	200	0.974799	0.968058	0.975006	48657.97	48311.36	48668.63
	240	0.974799	0.968058	0.975006	48657.97	48311.36	48668.63
	280	0.974799	0.968057	0.975006	48657.97	48311.36	48668.63
	320	0.974799	0.968057	0.975006	48657.97	48311.36	48668.63
	360	0.974799	0.968057	0.975006	48657.97	48311.36	48668.63
C=0.4	40	0.963157	0.9531	0.963467	48097.67	47580.36	48113.64
	80	0.963157	0.9531	0.963467	48097.67	47580.36	48113.64
	120	0.963157	0.9531	0.963467	48097.67	47580.36	48113.64
	160	0.963157	0.9531	0.963467	48097.67	47580.36	48113.63
	200	0.963157	0.9531	0.963467	48097.67	47580.36	48113.64
	240	0.963157	0.9531	0.963467	48097.67	47580.36	48113.63
	280	0.963157	0.9531	0.963467	48097.67	47580.36	48113.64
	320	0.963157	0.9531	0.963467	48097.67	47580.36	48113.64
	360	0.963157	0.9531	0.963467	48097.67	47580.36	48113.64
C=0	40	0.9548	0.9548	0.9548	47707.69	47707.69	47707.69
	80	0.954799	0.954799	0.954799	47707.68	47707.68	47707.68
	120	0.954797	0.954797	0.954797	47707.52	47707.52	47707.52
	160	0.954796	0.954796	0.954796	47707.49	47707.49	47707.49
	200	0.954795	0.954795	0.954795	47707.47	47707.47	47707.47
	240	0.954794	0.954794	0.954794	47707.42	47707.42	47707.42
	280	0.954793	0.954793	0.954793	47707.37	47707.37	47707.37
	320	0.954791	0.954791	0.954791	47707.26	47707.26	47707.26
	360	0.95479	0.95479	0.95479	47707.09	47707.09	47707.09

CONCLUSIONS

The fuzzy availability and performance analysis of paint manufacturing plant discussed above can play a key role in increasing the production of the plant. From the above analysis, it explores that coverage factor has a prominent role in the fuzzy availability and profit of the system. A critical and comparative analysis shows that labeling machine and filling machine unit have a prominent effect on the system in comparison to other units. Finally, it is conclude that by improving the process of fault coverage, increasing the repair rate of labeling unit, increasing the repair rate of filling unit and adopting proper maintenance policies the fuzzy availability and profit function will be improved.

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